CLAIMS

What is claimed is:

1. A machine-readable medium having stored thereon instructions, which when executed by one or more processors, cause said processors to perform the following:

   a) create a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a cross capacitor;

   b) reduce said string to a pi model, said pi model having a cross capacitor; and

   c) simulate the application of an applied noise voltage to said cross capacitor.

2. The machine-readable medium of claim 1 wherein said reduce said string to a pi model further comprises reducing the number of capacitors and resistors in said string.

3. The machine-readable medium of claim 2 wherein said reducing said string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

4. The machine-readable medium of claim 3 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

5. The machine-readable medium of claim 3 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

6. The machine-readable medium of claim 1 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

7. The machine-readable medium of claim 1 wherein said application of a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

8. The machine-readable medium of claim 7 wherein the ramp time of said voltage ramp is multiplied by a factor to correct for the characteristics of an actual driving transistor.

9. The machine-readable medium of claim 1 wherein said instructions are such that said reduce said string to a pi model may be performed on a first apparatus

and said create a string that models a trace may be performed on a second apparatus.

10. The machine-readable medium of claim 1 further comprising instructions that add a resistor to said pi model as a linear source model.

11. The machine-readable medium of claim 1 further comprising instructions that allow a user to observe a noise voltage waveform on a victim node of said pi model.

12. The machine-readable medium of claim 1 further comprising instructions that calculate the peak noise voltage on a victim node of said pi model caused by said applied noise voltage.

13. The machine-readable medium of claim 1 further comprising instructions that apply a second applied noise voltage to a second cross capacitor of said pi model.

14. The machine-readable medium of claim 13 wherein said applied noise voltage and said second applied noise voltage are voltage ramps having their end or ramp times in phase.

15. The machine-readable medium of claim 13 further comprising instructions that calculate the peak noise caused by said applied noise voltage and said second applied noise voltage at a source point of said pi model.

16. The machine-readable medium of claim 13 further comprising instructions that calculate the peak noise caused by said applied noise voltage and said second applied noise voltage at a load point of said pi model.

17. The machine-readable medium of claim 1 wherein said reduce said string to a pi model further comprises reducing said string to a reduced string then reducing said reduced string to a simple string having resistors is series and capacitors in parallel, said capacitors separated by one of said resistances, then reducing said simple string to a pi-model.

18. A machine-readable medium having stored thereon instructions, which when executed by one or more processors, cause said set of processors to perform the following:

a) create a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a plurality of cross capacitors on a node, each of said cross capacitors corresponding to a different proximate trace;

b) add said plurality of cross capacitors together to form a reduced string;

c) reduce said reduced string to a pi model, said pi model having a cross capacitor; and

d) simulate the application of an applied noise voltage to said cross capacitor.

19. The machine-readable medium of claim 18 wherein said reduce said reduced string to a pi model further comprises reducing the number of capacitors and resistors in said reduced string.

20. The machine-readable medium of claim 19 wherein said reduce said reduced string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

21. The machine-readable medium of claim 20 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

22. The machine-readable medium of claim 20 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

23. The machine-readable medium of claim 18 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

24. The machine-readable medium of claim 18 wherein said apply a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

25. The machine-readable medium of claim 24 wherein said voltage ramp further comprises an equivalent ramp time that approximates the worst case noise caused by said plurality of proximate traces.

26. The machine-readable medium of claim 18 wherein said instructions are such that said reduce said reduced string to a pi model may be performed on a first apparatus and said create a string that models a trace may be performed on a second apparatus.

27. The machine-readable medium of claim 18 wherein said reduce said reduced string to a pi model further comprises reducing said reduced string to a simple string then reducing said simple string to a pi-model.

28. An apparatus, comprising:

a computer having a design tool configured to:

a) recognize a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a cross capacitor;

b) reduce said string to a pi model, said pi model having a cross capacitor; and

c) simulate the application of an applied noise voltage to said cross capacitor.

29. A machine-readable medium having stored thereon instructions which when executed by one or more processors cause said processors to perform the following:

calculate a plurality of discrete samples from an overall applied noise voltage waveform and simulate the application of each of said plurality of discrete samples to a cross capacitor, said cross capacitor associated with a pi model, said pi model reduced from a string.

30. The machine-readable medium of claim 29 further comprising instructions that assemble a plurality of observed noise voltages from the simulation of the application of each of said discrete samples.

31. The machine-readable medium of claim 30 further comprising instructions that display an overall observed noise voltage waveform produced from said plurality of observed noise voltages.

32. The machine-readable medium of claim 29 wherein said overall applied noise voltage waveform is a ramp.

33. A method, comprising:

a) create a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a cross capacitor;
b) reduce said string to a pi model, said pi model having a cross capacitor; and
c) simulate the application of an applied noise voltage to said cross capacitor.

34. The method of claim 33 wherein said reduce said string to a pi model further comprises reducing the number of capacitors and resistors in said string.

35. The method of claim 34 wherein said reducing said string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

36. The method of claim 35 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

37. The method of claim 35 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

38 The method of claim 33 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

39. The method of claim 33 wherein said application of a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

40. The method of claim 39 wherein the ramp time of said voltage ramp is multiplied by a factor to correct for the characteristics of an actual driving transistor.

41 The method of claim 33 wherein said reduce said string to a pi model is performed on a first apparatus and said create a string that models a trace is performed on a second apparatus.

42. The method of claim 33 further comprising add a resistor to said pi model as a linear source model.

43 The method of claim 33 further comprising observe noise voltage on a victim node of said pi model.

44. The method of claim 33 further comprising calculate the peak noise voltage on a victim node of said pi model caused by said applied noise voltage.

45. The method of claim 33 further comprising apply a second applied noise voltage to a second cross capacitor of said pi model.

46. The method of claim 45 wherein said applied noise voltage and said second applied noise voltage are voltage ramps having their end or ramp times in phase.

47. The method of claim 45 further comprising calculate the peak noise caused by said applied noise voltage and said second applied noise voltage at a source point of said pi model.

48. The method of claim 45 further comprising calculate the peak noise caused by said applied noise voltage and said second applied noise voltage at a load point of said pi model.

49. The method of claim 33 wherein said reduce said string to a pi model further comprises reducing said string to a reduced string then reducing said reduced string to a simple string having resistors and capacitors in parallel, said capacitors separated by one of said resistors then reducing said simple string to a pi-model.

50. A method, comprising:

a) create a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a plurality of cross capacitors on a node, each of said cross capacitors corresponding to a different proximate trace;

b) add said plurality of cross capacitors together to form a reduced string;

c) reduce said reduced string to a pi model, said pi model having a cross capacitor; and

d) simulate the application of an applied noise voltage to said cross capacitor.

51. The method of claim 50 wherein said reduce said reduced string to a pi model further comprises reducing the number of capacitors and resistors in said reduced string.

52. The method of claim 51 wherein said reduce said reduced string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

53. The method of claim 52 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

54. The method of claim 52 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

55. The machine-readable medium of claim 50 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

56. The method of claim 50 wherein said apply a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

57. The method of claim 56 wherein said voltage ramp further comprises an equivalent ramp time that approximates the worst case noise caused by said plurality of proximate traces.

58. The method of claim 50 wherein said reduce said reduced string to a pi model is performed on a first apparatus and said create a string that models a trace is performed on a second apparatus.

59. The method of claim 50 wherein said reduce said reduced string to a pi model further comprises reducing said reduced string to a simple string then reducing said simple string to a pi-model.

60. A method, comprising:

calculate a plurality of discrete samples from an overall applied noise voltage waveform and simulate the application of each of said plurality of discrete samples to a cross capacitor, said cross capacitor associated with a pi model, said pi model reduced from a string.

61. The method of claim 60 further comprising assemble a plurality of observed noise voltages from the simulation of the application of each of said discrete samples.

62. The method of claim 61 further comprising display an overall observed noise voltage waveform produced from said plurality of observed noise voltages.

63. The method of claim 60 wherein said overall applied noise voltage waveform is a ramp